O. O. KRUH.

TELEPHOTOGRAPHY.

APPLICATION FILED NOV. 19, 1907.

968,484.

Patented Aug. 23, 1910.

2 SHEETS—SHEET 1.

Fig. 1.

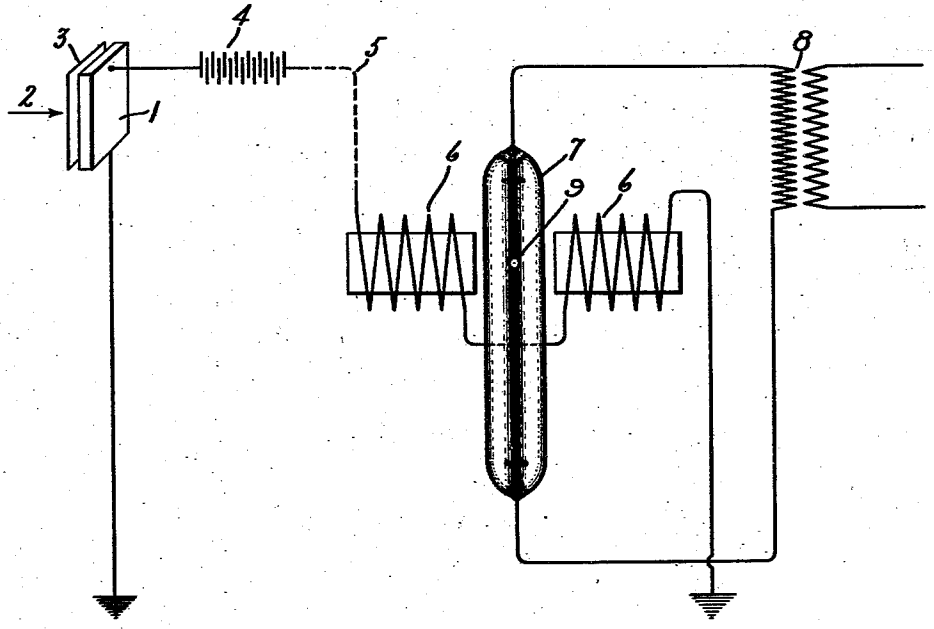
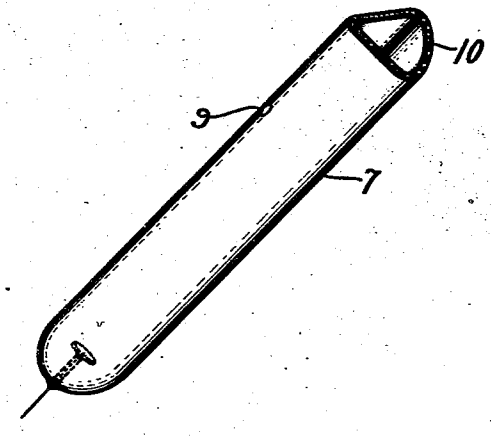


Fig. 2.



Witnesses:

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2 SHEETS—SHEET 2.

Fig. 3.

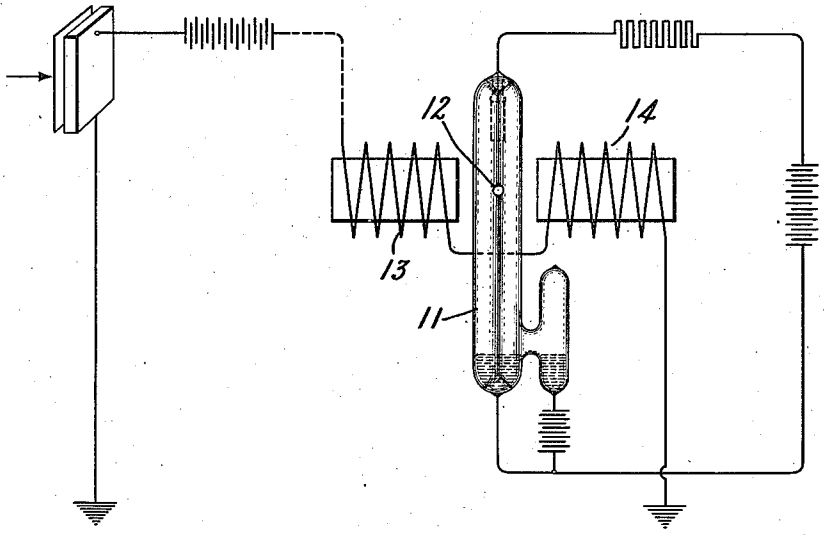
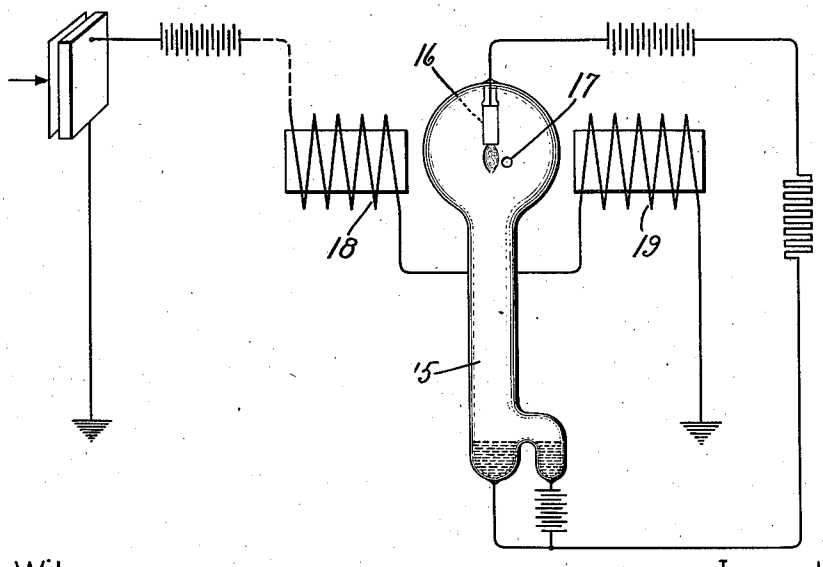


Fig. 4.



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UNITED STATES PATENT OFFICE.

OSIAS OTTO KRUH, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

TELEPHOTOGRAPHY.

968,484. Specification of Letters Patent. Patented Aug. 23, 1910.

Application filed November 19, 1907. Serial No. 402,787.

To all whom it may concern:

Be it known that I, OSIAS OTTO KRUH, a subject of the Emperor of Austria-Hungary, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Telephotography, of which the following is a specification.

A complete telephotographic system ordinarily comprises a sending station, a transmission line, and a receiving station. The sending station is provided with means for projecting a small ray of light through a photographic negative, with means on the other side of the negative for varying or controlling an electric circuit in proportion to the light transmitted through the negative. A selenium cell is suitable for regulating the electric current to correspond with variations in the light transmitted, when the spot of light is made to travel progressively over the surface of the negative. The variations in current above mentioned act on a suitable receiving apparatus at the distant station and are used to reproduce, on a sensitized surface, the light and dark spots of the original negative. The reproduction is a "positive" of the distant negative.

A system of the general type above-mentioned is described by Korn in the *Elektrotechnische Zeitschrift*, Vol. 26, p. 1131, 1905.

My present invention comprises an improved receiving apparatus whereby the pulsations and fluctuations of the line current can be utilized to the best advantage in the reproduction of the negative used at the sending end of the line.

The receiving apparatus hereinafter described is very simple in construction and operation and will record pictures with much greater rapidity than any other type of apparatus known to me.

In order to avoid confusion, and to simplify this application, I have confined my description largely to my own particular improvements, and have omitted the mechanical details whereby the spot of light is made to move progressively over the negative at the sending station, and whereby a synchronously operating sensitive surface is moved with respect to the source of light at the receiving station.

The novel features of my invention are particularly pointed out in the appended claims, for a better understanding of which, reference is made to the following description taken in connection with the accompanying drawings. These drawings have purposely been made diagrammatic and as simple as possible.

Figure 1 represents a complete system having a receiving apparatus comprising a cathode ray tube; Fig. 2 is a broken perspective view of a special form of cathode-ray tube; Fig. 3 is a modification of my invention in which a mercury vapor arc tube is used; Fig. 4 illustrates the use of a special type of mercury arc tube.

The general system illustrated in Fig. 1 comprises a sending station having a selenium cell 1 receiving a ray of light 2 transmitted through a photographic negative 3 over which the spot is progressively moved. The variation in the intensity of the light falling on the selenium cell varies the resistance of the cell, in a well known manner, and thereby varies the intensity of the current supplied by a storage battery 4 and transmitted through a line conductor 5.

At the receiving end of the line is an electromagnet 6 energized by the fluctuating current sent out by the sending station. Within the influence of this electromagnet is a cathode-ray tube 7 energized in any suitable manner as by means of a Tesla transformer 8.

The cathode-ray tube is provided with an opaque covering over its entire surface except for a small opening 9 through which the rays are permitted to pass so that they may act on a photographic plate. The cathode-ray tube is so located with respect to the magnetic field that when the field is weak the luminous discharge through the tube is spread out through a wide area, and gives, at the window 9, an illumination of low intensity. If, however, the magnetic field is strongly increased as when the selenium cell 1 is greatly reduced in resistance by a strong light through the sending negative, the field acts to deflect the cathode rays and concentrate them in a path passing directly before the window 9. This increases the intensity of the light projected upon the photographic plate and produces thereon a highly exposed spot or trace corresponding to the spot or traces on the sending negative.

To intensify the concentrating action of the electromagnet 6 I prefer to make the

cathode ray tube of the special type illustrated in Fig. 2. The tube is semicircular along the back 10 but is wedge-shaped on the front and has the transparent window 9 at the apex of this wedge. The result is that when the magnetic field is shifted over toward the window it is also contracted sidewise to give a high luminous intensity immediately back of the window.

It should be noted that the system just described is entirely free from any moving parts and is thus well adapted to respond quickly to changes in the current transmitted over the line conductor. In this respect it is far superior to systems using movable coils and contacts, the inertia of which is so great that a photograph cannot be transmitted in less than about three to ten minutes.

In the modification shown diagrammatically in Fig. 3, the light giving source of the receiving station consists of a mercury arc lamp 11 energized by a storage battery or other source of direct current. This lamp, like the cathode ray tube illustrated in Fig. 1, has an opaque coating and a transparent window 12 and is wedge-shaped in cross-section to facilitate the concentration of the arc immediately back of the transparent window 12. The operation is essentially the same as that recited in connection with Fig. 1. I find that when a mercury arc device is used, the magnetic field produced by electromagnets 13 and 14 must be relatively strong to secure the desired fluctuation in the intensity of the light at the window. When the electromagnets are strong, they necessarily offer some considerable inductance and thus tend somewhat to limit the speed at which pictures can be transmitted. The modification illustrated in Fig. 4 is not subject to this disadvantage. The tube has the characteristic of extreme sensitiveness; consequently the magnetic field can be relatively weak; it will then offer little impedance to the fluctuating current of the line.

In Fig. 4 the mercury vapor apparatus 15 is provided with a hollow anode 16. I find that when such an apparatus is running under normal conditions there may be found inclosed within the hollow anode a sort of halo or flame differing essentially from the main body of the arc. I have found that when such an apparatus is properly located in a magnetic field, this halo or tongue of flame protrudes from the hollow anode to an extent about proportional to the strength of the magnetic field. I make use of these peculiar phenomena by locating the transparent window 17 somewhat below and to one side of the end of the hollow anode 16 and in such position that the magnetic field established by electromagnets 18 and 19 will cause the halo to be thrust out of the hollow anode and then deflected sidewise until it is immediately back of the window. As previously stated, this movement of the halo can be effected with a very weak magnetic field; consequently the electromagnets 18 and 19 may have but a few turns and will offer little impedance to the line current of the system. The halo above mentioned is particularly sensitive when the mercury arc is running at a low current, or when the mercury vapor is at low pressure.

It will be clearly understood that in the several types of apparatus above described the illumination of the window will vary progressively from bright to dark in about the proportion of the current variations in the line, that is, with high current the concentration of the light at the window will be at a maximum, whereas with but a moderate current the illumination will be lower and will give what may be called a half-tone exposure to a part of the receiving photographic plate.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

1. In a telephotographic system, a luminous tube having a light transmitting window, and electromagnetic means for varying the intensity of light at said window to correspond with the variations in current received from a distant point.

2. In a system of telephotography, a receiving apparatus comprising an evacuated envelop maintained luminous by electrical energy, said envelop having a light transmitting window, and means for controlling the distribution of current through said envelop to control the illumination at said window in a manner to correspond with the variations in current transmitted to said receiving apparatus from a distant station.

3. The combination of an evacuated envelop having opaque walls and a light transmitting window, means for passing current through said envelop to render it luminous, and magnetic means for shifting the path of current in said envelop to vary the intensity of light at said window.

4. The combination of a source of light inclosed in an opaque envelop having a light transmitting window, a source of electrical energy for maintaining said source of light, and electromagnetic means for controlling the distribution of current within said envelop to vary the intensity of the light transmitted through said window.

5. The combination of an evacuated envelop having a substantially wedge-shaped cross-section, an opaque coating therefor having a light transmitting window near the apex of the wedge, means for passing current through said tube, and magnetic means for shifting the distribution of said current to vary the intensity of light transmitted through said window.

6. In a system of telephotography, the

combination of a mercury vapor lamp having an opaque covering with a light transmitting window, an anode for said mercury lamp, means for supplying current to said lamp to maintain a halo at said anode, and an electromagnet sensitive to the variations of current received from a distant point and operative to shift the position of said halo with respect to said light transmitting window.

7. In a system of telephotography, the combination of means for establishing a luminous electrical discharge, means for isolating a beam of light produced thereby, and electromagnetic means acting directly upon the discharge so as to produce successive variations of actinic intensity in said beam.

8. The combination of a source of electrical energy, a vapor electric device, comprising a suitable envelop connected to said source, means for establishing a beam of light from said device in a given direction, an electromagnetic means for varying the intensity of said beam in such manner as to produce a succession of varying impressions upon a photographic surface.

In witness whereof, I have hereunto set my hand this 18th day of November, 1907.

OSIAS OTTO KRUH.

Witnesses:
BENJAMIN B. HULL,
HELEN ORFORD.